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The Home Energy Scoring Tool: A Simplified Asset Rating for Single Family Homes

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Acknowledgements

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U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

Building Technologies Program

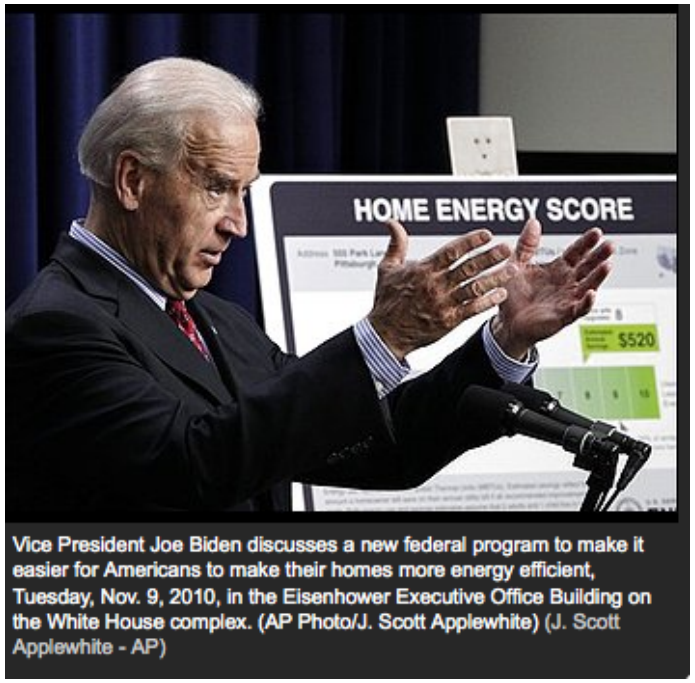
Inception

In early 2010, the Department of Energy began a residential labeling initiative within the Recovery Through Retrofit plan of the American Recovery and Reinvestment Act.

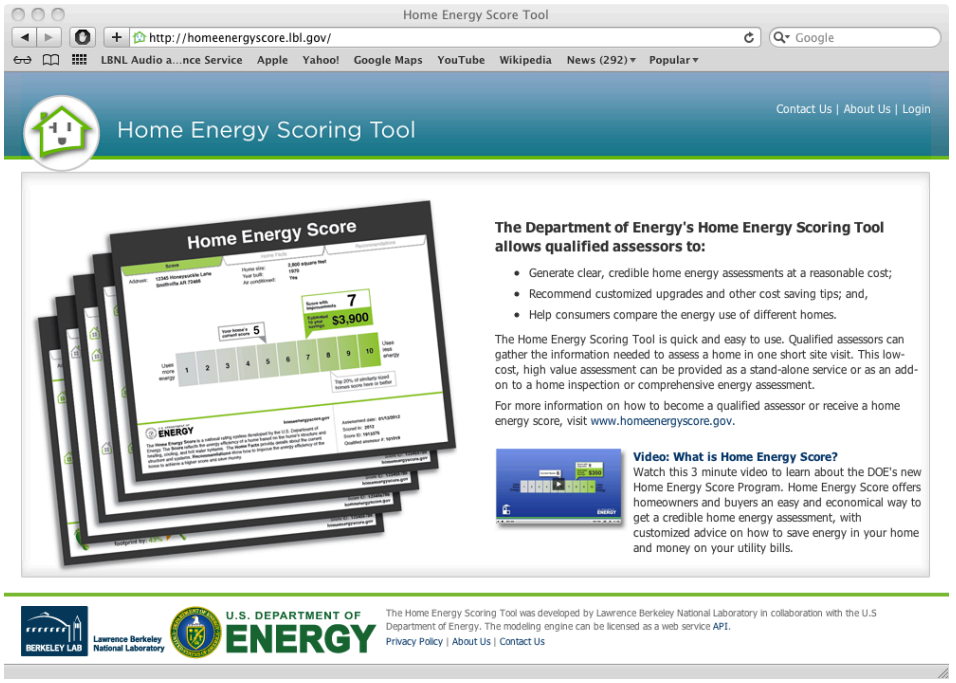
Primary Goal

To provide standardized energy assessment information for homeowners, buyers and sellers of detached single-family and townhome buildings in the United States.

Home Energy Scoring Tool



Vice President Joe Biden discusses a new federal program to make it easier for Americans to make their homes more energy efficient, Tuesday, Nov. 9, 2010, in the Eisenhower Executive Office Building on the White House complex. (AP Photo/J. Scott Applewhite) (J. Scott Applewhite - AP)



- LBNL develops Beta version of the Home Energy Scoring Tool drawing from Home Energy Saver models and methods.
- Program launched by Vice President Biden November 9, 2010
- Pilot Tests of Beta version Scoring Tool Spring-Summer 2011 (in 9 regions)
- National Launch (version 2012) of the Tool is live and >21 Partners (in 13 states) are participating.

Asset Rating

An asset rating seeks to evaluate a home's fixed characteristics, while holding occupant-determined factors and behaviors constant.

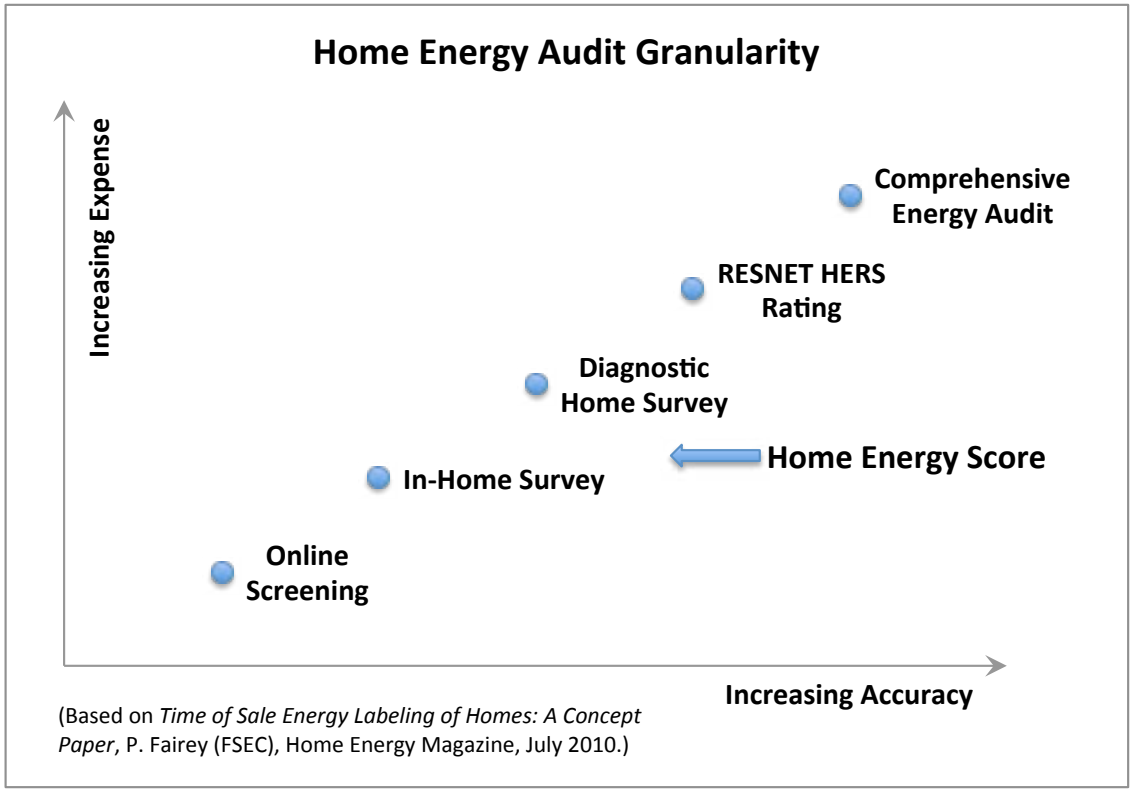
There are various opinions on which energy-using components are "Assets."

For the Home Energy Scoring Tool:

- Asset - HVAC, water heaters and all envelope components
- Not Asset - Lighting, appliances and other equipment

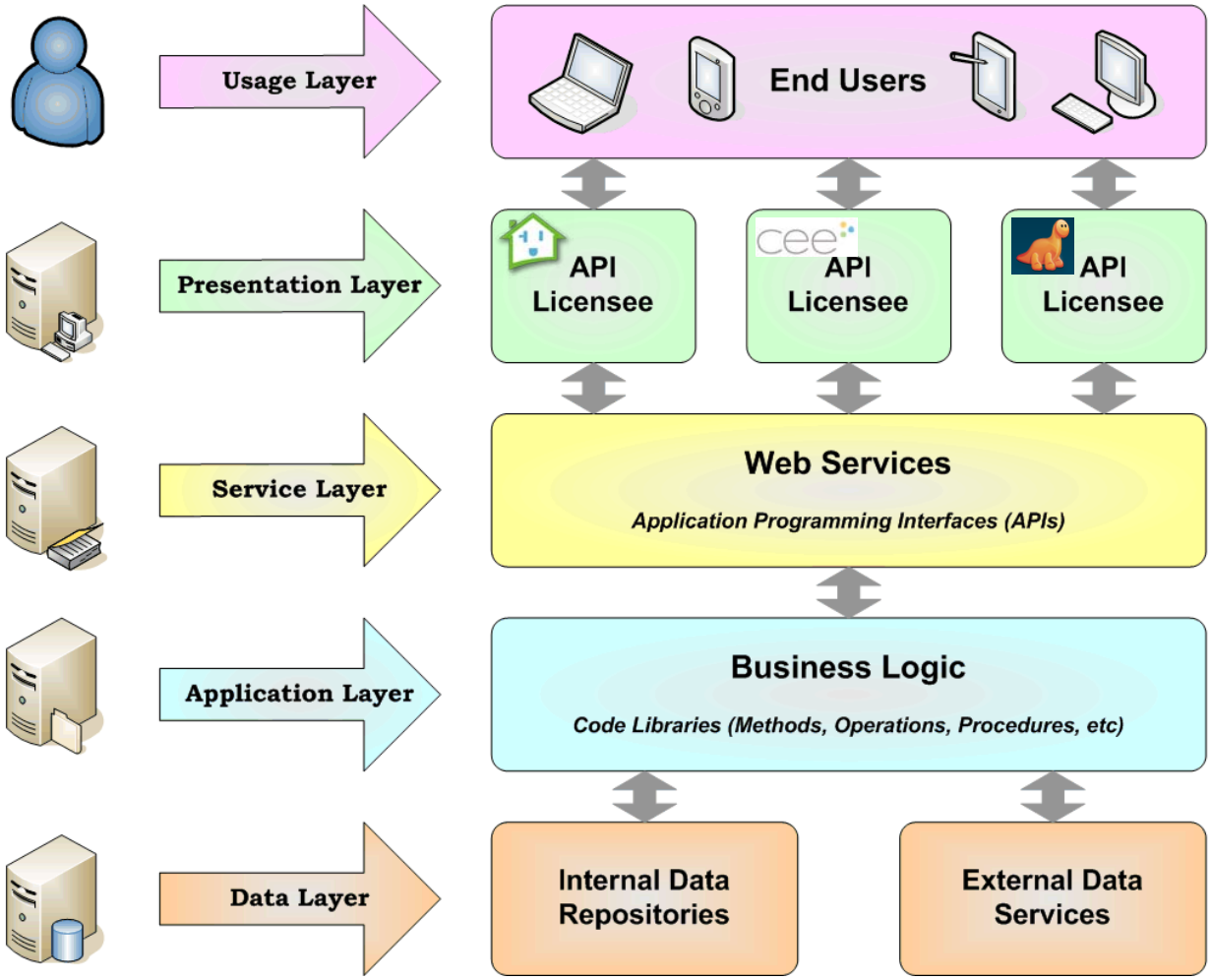
Program & Tool - Design Considerations

- General Objectives
  - Accuracy
  - Transparency
  - Innovation
- Time-of-sale & Other cross-home comparison situations
- 1 hour assessment time
  - Affordable price point
  - "Opportunity Assessment" resolution
- Support (not compete with) existing marketplace of Tools & Services
  - Stimulate Retrofit Market
  - Private tool development & innovation (Web Services)
  - Help with reduced up-front assessment cost



(Based on *Time of Sale Energy Labeling of Homes: A Concept Paper*, P. Fairey (FSEC), Home Energy Magazine, July 2010.)

Home Energy Score - Web Services (API)



Current Licensees

- MNCEE
- EnergySavvy
- EnergySoft
- Another 35+ sign-ups are in process

Mobility

"…conduct a home rating with a hand-held tool…"
Cathy Zoi, Former DOE-EERE Assistant Secretary
Opening Keynote, ACEEE 2010 Summer Study

Minnesota CEE Mobile App for Scoring Tool

"…conduct a home rating with a hand-held tool…"
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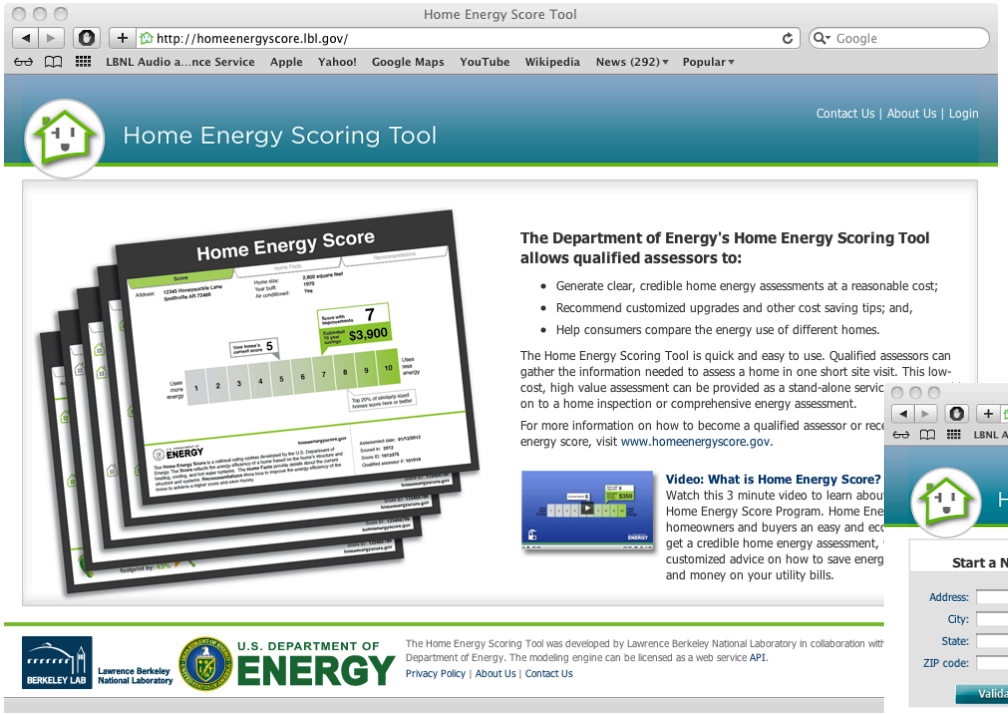
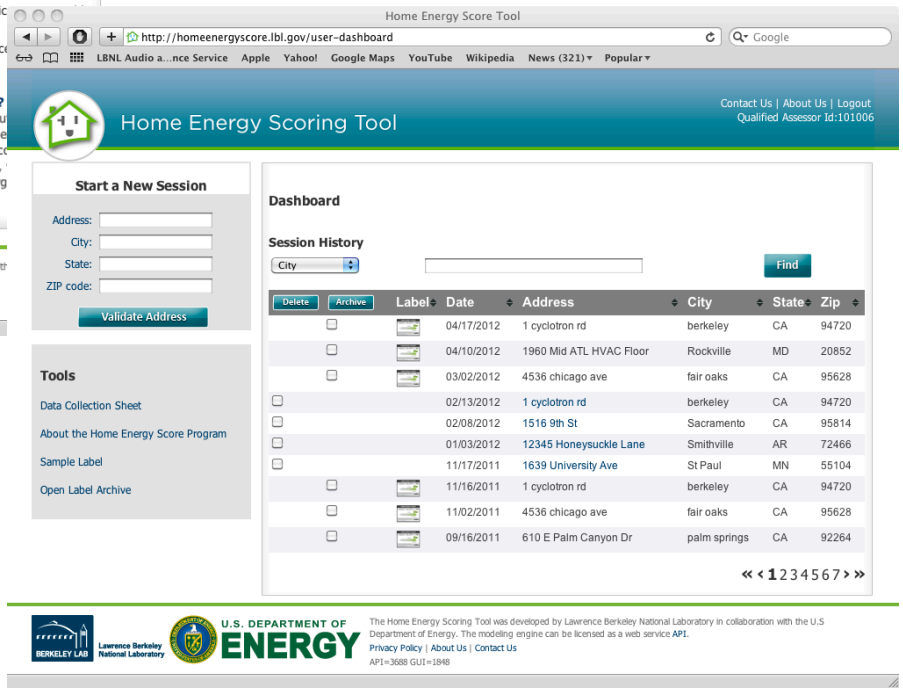
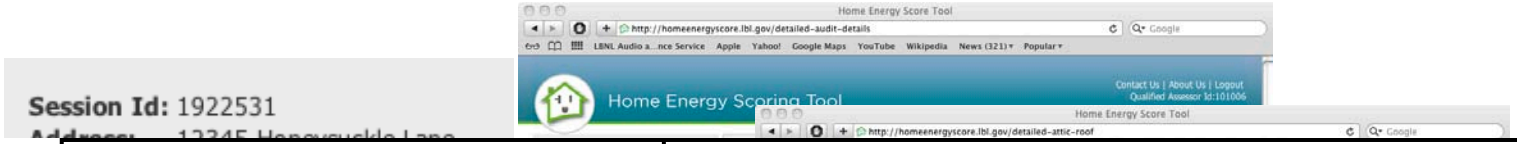
Courtesy Richard Szydlowski, MNCEE

Scoring Tool – A Very Quick Tour

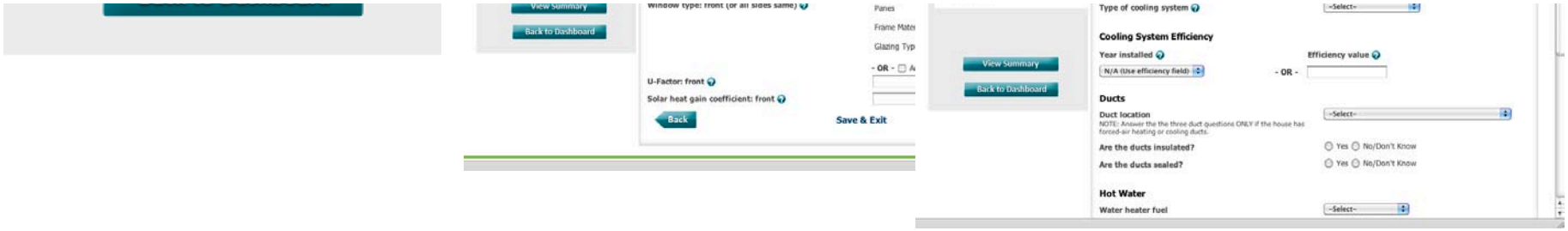




Quick Tour - Required Inputs



About this Home	Assessment date, Physical address, Year built, Conditioned floor area, Number bedrooms, Number Floors, Ceiling height, Orientation, Air leakage rate, Auditor comments
Roof, Attic & Foundation	Roof construction, Roof surface solar absorption, Attic or ceiling type, Attic floor insulation, Foundation type, Foundation insulation level, raised floor insulation level
Walls	Walls the same on all sides indicator, Wall construction(s) layers
Windows & Skylights	Skylights present, Skylight type, Skylight total area, Windows the same on all sides indicator, Window type(s) or custom input of U-Factor/Solar Heat Gain Coefficient
Systems	Heating system type & efficiency, Cooling system type & efficiency, Duct location, Duct insulation, Duct sealing status, Domestic hot water system type & efficiency, Combined space and water heating type



Fixed Assumptions & Default Values

- Occupancy and TV energy are scaled per the number of bedrooms as defined in the Building America House Simulation Protocols (Hendron & Engebrecht, Oct. 2010)
  - Up to 3 bedrooms the occupant/bedroom ratio equals 1, then gradually scales downward for 4 bedrooms and higher homes
  - TV kWh = -3 * (number Bedrooms)^2 + 89 * (number of Bedrooms) + 390
- Domestic hot water load dependent on occupancy level
- Misc. electric loads scaled by conditioned floor area (Hendron & Engebrecht, Oct. 2010)
  - Residual misc. elec. kWh = 0.91 * (conditioned floor area)
- Stove, oven, and clothes-drying fuels are set as electric
- Lighting
  - Interior lighting kWh = 455 + 0.8 * conditioned floor area
  - Exterior lighting kWh = 50 + 0.05 * conditioned floor area
- The building length and width are fixed at a 5:3 aspect ratio
- The thermostat set point is scheduled all year as:
  - 08:00-17:00 Heating 64°F, Cooling 81°F
  - 17:00-08:00 Heating 68°F, Cooling 78°F

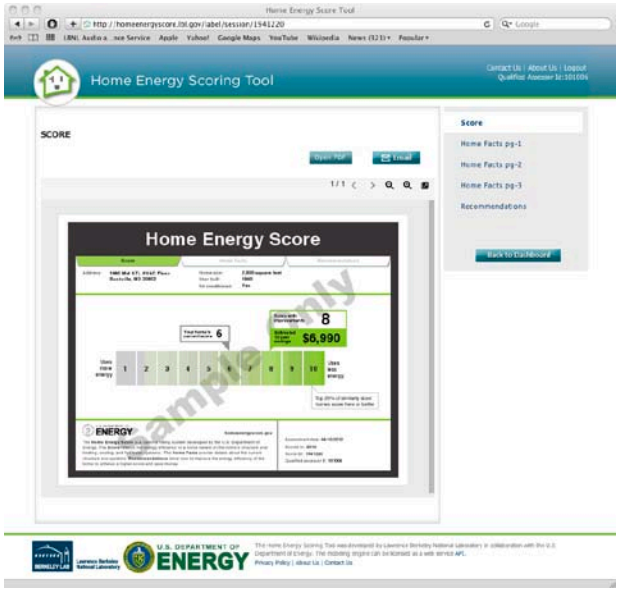
Detailed engineering documentation located at http://hespro.lbl.gov/pro/documentation

Scoring Methodology

The scoring objective is to provide a simple system to help consumers understand how their home compares in energy performance through a nationally standardized scale, self adjusting as much as possible for regional construction differences, regionally dominant energy supplies and differing climate.

Solution

Source energy bin sets, one for each weather data file in the Scoring Tool system.*



	1	2	3	4	5	6	7	8	9	10
Weather station	**Greater than**	**Up to**	**Up to**	**Up to**	**Up to**	**Up to**	**Up to**	**Up to**	**Up to**	**Up to**
station name	425	425	394	363	332	301	270	239	208	177
⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮
245 locations	*x* Mbtu	*x* Mbtu	*x* Mbtu	*x* Mbtu	*x* Mbtu	*x* Mbtu	*x* Mbtu	*x* Mbtu	*x* Mbtu	*x* Mbtu

* Deru, M. and Torcellini, P. 2007, *Source Energy Factors - Source Energy and Emission Factors for Energy Use in Buildings*. NREL-38617. Tables 2 and 5.

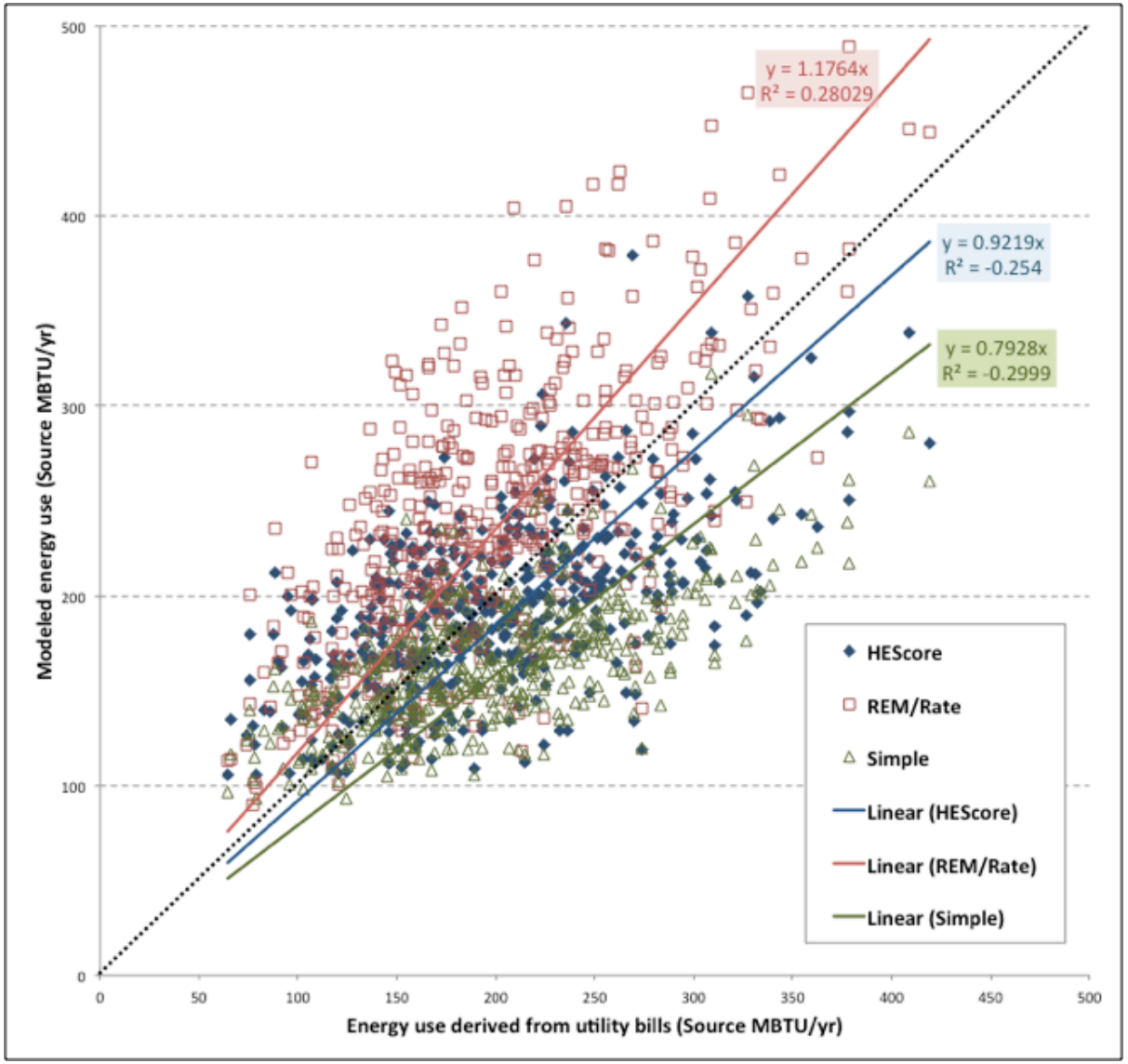
Accuracy Considerations

	Home Energy Scoring Tool (Version 2012)	SIMPLE	REM/Rate
Mean Predicted (MBtu)	196	165	244
Mean Measured (MBtu)	200	200	200
Mean Difference (MBtu)	-4	-35	44
Median Difference (MBtu)	1	-30	44
Standard Deviation of Difference (MBtu)	62	58	64
Percent of Homes < ± 25% Difference	61%	58%	47%
Percent of Homes < ± 50% Difference	88%	96%	75%

- Scoring Tool showed good agreement to measured source energy data
- Median difference between Scoring Tool predicted vs. measured is estimated at -4 MBtu (-2%)

Data source: NREL Field Data Repository (Roberts, et al. 2012)
Test reports avail. at www.homeenergyscore.gov

Accuracy Considerations



- Scoring Tool showed good agreement to measured source energy data
- Median difference between Scoring Tool predicted vs. measured is estimated at -4 MBtu (-2%)
- When all conceivable modeling uncertainties are included, testing showed that the correct score is assigned within +/- 0.5 bin 67% of the time.

Data source: NREL Field Data Repository (Roberts, et al. 2012)
Thanks to Phil Farese for the uncertainty analysis & plots.
Test reports avail. at www.homeenergyscore.gov

Assessing Upgrade Opportunities

Repair Now - These upgrades can help you save energy right away

- Attic floor insulation
- Basement wall or foundation slab edge insulation
- Floor insulation above a basement or crawlspace
- Crawlspace wall insulation
- Building air-sealing
- Exterior wall insulation
- Duct sealing
- Duct insulation

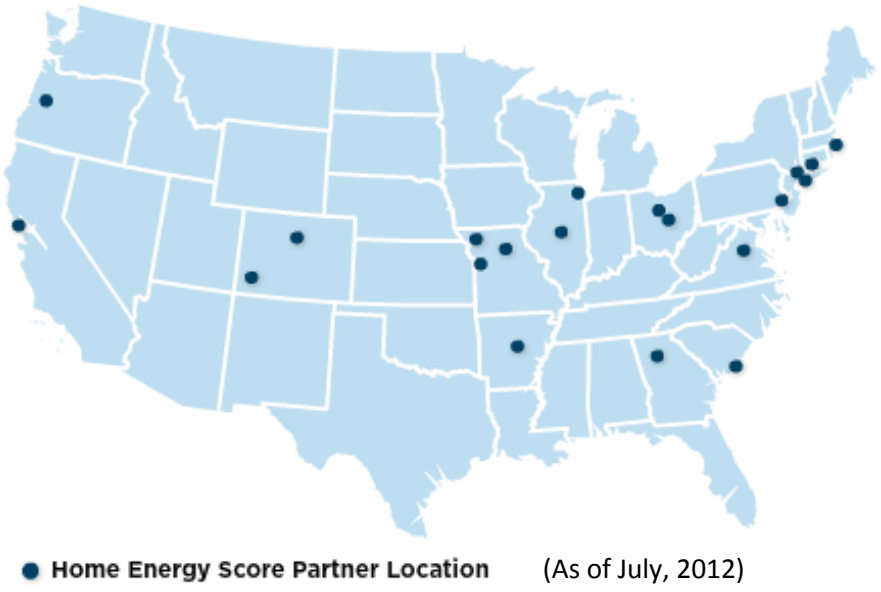
Replace Later - Recommendations for when you replace the affected equipment at a later time when needed or desired.

- Central air conditioner – ENERGY STAR unit
- Boiler or Furnace or Heat pump – ENERGY STAR unit
- Room air conditioner – ENERGY STAR unit
- Roof – increased reflectance
- Roof – insulated sheathing
- Skylights – ENERGY STAR units
- Siding – insulated exterior sheathing
- Water heater – ENERGY STAR unit
- Windows – ENERGY STAR units

Program Partners

Participation in the Home Energy Score program and use of Scoring Tool(s) require becoming a DOE Qualified Assessor (QA)

- Must be working directly with a Home Energy Score Local Partner program
- Be certified by the Building Performance Institute (BPI) or by a Residential Energy Services Network (RESNET) Provider, and
- Complete and receive a passing grade on the DOE's Home Energy Score two part online test



(As of July, 2012)

Next Steps

- Increase number of regions and Program Partners
- Annual (calendar year) update to the standardized calculation methods & Scoring Tool(s) GUI
- Possible future modeling features (not limited to these examples):
  - Multiple construction types (roofs, foundations, floors, etc.)
  - Solar (photovoltaic, thermal)
  - Pool equipment
  - Improved ground source heap pump modeling
  - TMY3 weather data (~1000 locations)
- Scoring session data interoperability to the Home Energy Saver websites (operational energy simulation)
- Long-term: Develop synergistic research and energy efficiency program uses of the Building Registry data

Thank you

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